FORM PTO-1390 (REV. 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 10191/1963

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/913484

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE(S) CLAIMED
PCT/DE00/00380	(08.02.00) 8 February 2000	(19.02.99) 19 February 1999

TITLE OF INVENTION
METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM

APPLICANT(S) FOR DO/EO/US

VOLLMER, Vasco; and RADIMIRSCH, Markus

Applicant(s) herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (unsigned).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☒ A substitute specification and a marked up version thereof.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report (translated), International Preliminary Examination Report (translated), and Form PCT/RO/101.

Express Mail No. EL244503775US

U.S. APPLICATION NO. if known, see 37 C.F.R.1.5	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/913484	PCT/DE00/00380	10191/1963

17. ☒ The following fees are submitted:

	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO $860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) ... $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	13 - 20 =	0	X $18.00	$	
Independent Claims	3 - 3 =	0	X $80.00	$	
Multiple dependent claim(s) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$860	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$860	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$860	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$860	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of $860.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

By: Reg No 35,952

SIGNATURE

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8/15/01
DATE

[10191/1963]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Vasco VOLLMER et al.
Serial No.	:	To Be Assigned
Filed	:	Herewith
For	:	METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM
Art Unit	:	To Be Assigned
Examiner	:	To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT AND
37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend the above-identified application before examination, as set forth below.

IN THE TITLE:

Please replace the title with the following:

--METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM--.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

Please cancel claims 1-13 in the underlying PCT application, without prejudice.

Please also cancel claims 1-12 in the annex to the International Preliminary Examination Report, without prejudice.

Please add the following new claims:

13. 13. (New) A method of effective utilization of data packets of differing capacity, comprising:

exchanging user data packets and control data packets between a master station and subscribers, the user data packets having a data capacity which is a multiple of a data capacity of the control data packets;

filling at least some containers for the user data packets each with a plurality of control data packets in a transmission frame according to an agreement between the master station and at least one of the subscribers, the agreement stipulating which of the containers for the user data packets are filled with control data packets, the control data packets which are stored in the containers for the user data packets being combined in a subframe, an external format of the subframe being adapted to a format of the user data packets; and

transferring the user data packets and the control data packets between the master station and the subscribers in a communications system having frame-oriented transmission.

14. (New) The method according to claim 13, further comprising:

announcing the agreement by transmitting an announcement in a control data packet in advance of transferring the containers for the user data packets filled with control data packets.

15. (New) The method according to claim 13, further comprising:

announcing the agreement using an announcement in a header field of the containers for the user data packet filled with control data packets.

16. (New) The method according to claim 13, further comprising:

making the agreement by transmitting a request signal from the at least one of the subscribers to the master station.

17. (New) The method according to claim 13, further comprising:

assigning to one of the subscribers by the master station a container for user data packets for transmission of control data packets after a predetermined number of requests for control data packets by the one of the subscribers.

18. (New) The method according to claim 13, further comprising:

transmitting information regarding at least one of a type and a content of subsequent containers for user data packets filled with control data packets using at least a portion of a control data packet.

19. (New) The method according to claim 18, further comprising:

storing an information element in the at least the part of the control data packet, the information element containing information about a number of occupied fields for control data packets within a subsequent container for user data packets.

20. (New) The method according to claim 13, further comprising:

indicating information regarding a position of one of the containers for user data packets which is filled with control data packets within a block of user data packets using at least a portion of a control data packet.

21. (New) The method according to claim 13, further comprising:

arranging each of the containers for user data packets which is filled with control data packets in a predetermined position within a respective block of cohesive user data packets.

22. (New) The method according to claim 21, wherein each of the containers for the user data packets which are filled with control data packets is arranged at a beginning of the respective block of cohesive user data packets.

23. (New) The method according to claim 13, further comprising:

storing an information element in a preceding control data packet for each container for user data packets which is filled with control data packets.

24. (New) A master station for a communications system having a frame-oriented transmission of data packets of differing capacity between the master station and subscribers, the master station allocating communications resources in a form of data packets for the subscribers, the subscribers requesting the communications resources from the master station, the master station comprising:

a frame generator configured to predefine a transmission frame;

a multiplexer configured to insert control data packets and user data packets into the predefined transmission frame, a data capacity of the user data packets being a multiple of a data capacity of the control data packets;

a selection unit configured to determine, based on an agreement between the master station and at least one of the subscribers, whether containers for user data packets within the transmission frame are filled with control data packets; and

a demultiplexer configured to separate user data packets and control data packets transmitted in a transmission frame and configured to send the separated user data packets and control data packets to the selection unit.

25. (New) A subscriber device for a communications system having frame-oriented transmission of data packets of differing capacity between a master station and subscribes, the master station allocating communications resources in a form of data packets for the subscribers, the subscribers requesting the communications resources from the master station, the describer device comprising:

a demultiplexer configured to separate user data packets and control data packets from a transmission frame transmitted by the master station and configured to send the separated user data packets and control data packets to an analyzer unit;

a multiplexer configured to insert subscriber-side control data packets and user data packets into a transmission frame predefined by the master station, the user data packets having a data capacity that is a multiple of a data capacity of the control data packets; and

a selecting unit configured to determined whether containers for user data packets are filled with a plurality of control data packets within the transmission frame based on an agreement between the master station and the subscriber device.

Remarks

This Preliminary Amendment cancels, without prejudice, claims 1-13 in the underlying PCT Application No. PCT/DE00/00380. This Preliminary Amendment also cancels, without prejudice, claims 1-12 in the annex of the International Preliminary Examination Report, and adds new claims 13-25. The new claims conform the claims to the U.S. Patent and Trademark Office rules and does not add new matter to the application.

The amendments to the specification and abstract reflected in the substitute specification conform the specification and abstract to U.S. Patent and Trademark Office rules, and do not introduce new matter into the application.

The underlying PCT Application No. PCT/DE00/00380 includes an International Search Report, issued July 21, 2000, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

The underlying PCT Application No. PCT/DE00/00380 also includes an International Preliminary Examination Report, issued June 7, 2001. A translation of the International Preliminary Examination Report and annex thereto is included herewith.

It is respectfully submitted that the present invention is new, non-obvious, and useful. Prompt consideration and allowance of the claims are respectfully requested.

Respectfully Submitted,
KENYON & KENYON

By Reg. No. 35,952

Dated: 8/15/01

By: _____
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[10191/1963]

METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM

FIELD OF THE INVENTION

The present invention relates to a method of effective utilization of data packets of differing capacity transmitted between a master station and a plurality of subscribers in a communications system. In addition, the present invention relates to a master station for a communications system having frame-oriented transmission of data packets of differing capacity between the master station and a plurality of subscribers, as well as relating to a corresponding subscriber device.

BACKGROUND INFORMATION

In centrally controlled communications networks, e.g., in the centrally controlled wireless cellular network according to the HIPERLAN type 2 ETSI project, there is a master station ZE to which multiple subscribers or their terminals can be connected (see Figure 1). This wireless network operates on a connection-oriented basis, i.e., at least one connection must be established before data can be exchanged with other subscribers or their terminals connected to the network or to master station ZE. On the basis of subscriber requests, the master station assigns to the terminals the data rate they need on the medium they share. It is possible for a subscriber terminal to have more than one active virtual connection at the same time, as is the case with ATM. In one implementation of this network, both the resource requests by the terminals and the resource assignments by master station ZE are carried out per connection, i.e., the terminal transmits the quantity of data packets that must be transmitted for each of its connections. Supplying data rates during which data can be transmitted on the medium is considered a resource here.

Accordingly, master station ZE sends a resource assignment for each connection of the terminal. In other implementations of this network, however, there is the possibility of performing the resource assignment and resource request per terminal, i.e., the terminal itself can decide which data packets it will send. In the case of the resource assignment per connection, the fact that a data packet transmitted belongs to a connection is given implicitly by the assignment of master station ZE, so this information is already present in master station ZE and does not need to be additionally transmitted by the terminal.

In the case of the resource assignment per terminal, master station ZE does not have any advance information regarding to which connection of the terminal a received data packet belongs. In this variant, the terminal must therefore transmit this information additionally. The same thing is true of a resource request or assignment per traffic class, as discussed in detail in D. Petras, "Entwicklung und Leistungsbewertung einer ATM-Funkschnittstelle" [Development and performance evaluation of an ATM wireless interface], Dissertation at RWTH Aachen, Aachen, chapter 8.2, DynPara-PDU; and in D. Petras, U. Vornefeld, "Joint performance of DSA++MAC protocol for wireless ATM under realistic traffic and channel models" wmATM '98, Hangzhou, China 1998, chapter 4.

In the above-mentioned wireless network, two different data packet sizes are provided for the data to be transmitted. Short packets (approx. 6 bytes; short data container: KD) are used for transmission of control information, i.e., information that is not user data but instead is used to control and manage the network, e.g., to establish connections, to associate terminals, to perform handovers or to request retransmission of incorrectly received data packets. Long data containers LD have a length of approx. 54 bytes and are normally used to transmit user data. In addition to the user data per se, some other information which is very

closely related to the user data is also included, e.g., the sequence number or a checksum for error detection.

A transmission in a downlink direction (master station to subscriber) as well as in an uplink direction (terminal to master station) includes a number of control data packets KD at the beginning and a subsequent number of user data packets LD according to Figure 2. The exact number of control data packets KD and user data packets LD is specified by master station ZE in the resource assignment.

SUMMARY OF THE INVENTION

In accordance with the present invention, subscribers or their terminals are given an opportunity to use a container for user data packets for transmission of control information. This opportunity is advantageous in particular when long control information must be transmitted, as is the case in handover or terminal association (logging a terminal onto the master station before establishing data communication). In addition, due to the use of a container for user data packets for multiple short control data packets, the terminal is given an opportunity to send urgent control information even without a prior request.

Due to the simple possibility of sending control information in data containers actually intended for user data, the terminal has an opportunity to respond much more flexibly, rapidly and efficiently to a changed situation. This is very beneficial, in particular in wireless transmission with its rapidly changing wireless channel properties. In addition, in accordance with the example embodiment of the present invention, a terminal has an opportunity to transmit a large amount of control information more efficiently.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a master station connected to a network and wirelessly connected to terminals.

Figure 2 shows an exemplary embodiment of a set of control packets and user data packets.

Figure 3 shows filling a container for user data packets with control data packets.

Figure 4 a transmission burst of a subscriber terminal in an uplink.

Figure 5 the accommodation of a header field in addition to control data packets in a container for user data packets.

Figure 6 the announcement of a block of control data packets in a container for user data packets.

Figure 7 the design of the master station for a communications system according to the present invention.

Figure 8 the design of a subscriber device for a communications system according to the present invention.

DETAILED DESCRIPTION

There are two different types of data containers of differing capacities in the above-mentioned HIPERLAN type 2 communications network. Data packets having a length of approx. 6 bytes usually contain control information. They are referred to below as control data packets KD. Data packets having a length of approx. 54 bytes, i.e., having a data capacity amounting to a multiple of that of the above-mentioned data packets, contain, in addition to user data NF, only a short header field KF containing data (e.g., sequence number and error correction bits) belonging directly to the container contents. These data packets are referred to below as user data packets LD (Figure 3). User data packets LD and control data packets KD are exchanged between a master station ZE and subscriber terminals T using a frame-oriented transmission (Figure 1).

In particular in the case when a subscriber or its terminal T would like to transmit urgent control information, according to the present invention, terminal T is given an opportunity to fill a container for user data packets LD with a plurality of control data packets KD.

This is illustrated in Figure 3. In the transmission frame, a container for user data packets LD is filled with nine control data packets KD. To do so, however, master station ZE must know that it is not a normal container having user data. To this end, an agreement between master station ZE and a subscriber T according to the present invention is reached so that containers for user data packets LD are filled with control data packets KD which are transmitted together, and it specifies which containers for user data packets in the transmission frame are filled with control data packets KD in each case. There are different methods of reaching this agreement:

1. by having one terminal announce it in a preceding control data packet KD; this procedure presupposes an analysis of control data packets KD prior to analysis of user data packets;
2. by announcing the mode in header field KF of a user data packet LD;
3. by transmitting a request through a terminal T to master station ZE to be able to fill a container for user data packets with control data packets;
4. by establishing a fixed agreement that after a certain number of requests of control data packets KD by a terminal T, instead a container for user data packets LD is assigned by master station ZE for filling with control data packets KD.

Control data packets KD stored in containers for user data packets LD may be combined in a subframe whose external format is adapted to the format of a user data packet LD, even if the

number of control data packets KD to be transmitted at the moment is not sufficient to fill the container completely.

The four possibilities shown here for an agreement to fill containers for user data packets LD with control data packets KD are described below in detail.

In the first exemplary embodiment, data transmission of a terminal (transmission burst) involves an uplink by transferring a block of control data packets KD followed by a block of user data packets LD according to Figure 4. One of these control data packets KD or a portion thereof is used to transfer information about the content of a subsequent container for user data packets which is filled with a block of control data packets KD (LD control according to Figure 4). To do so, a new information element IE is defined which determines the number of occupied fields for control data packets KD within a certain container for user data packets LD. In addition, information must be included which determines which of the subsequent containers is intended for user data packets LD (shown as an arrow in Figure 4). This may be a pointer - for example, the information that the n-th container for user data packets contains x control data packets KD. A determination can also be implemented that all containers for user data packets LD that are filled with a sequence of control data packets KD must be sent at a certain position within a block of user data packets, e.g., at the beginning (not shown in Figure 4). In this case, it is sufficient to merely state the number of control LD. This information element is sent by the terminal in one of control data packets KD that is present anyway. Another possibility is that there is an information element IE in a previous control data packet KD for each user data packet LD, so that the assignment is made simply by the sequence.

It may be possible, as explained above, to insert a field into the container for user data packets LD, in particular into the

header field, containing the information about which type of information it contains. This is labeled as a flag field in Figure 5. One bit, for example, is sufficient for this. This is followed then by another field (number of KD) which contains the number of the following control data packets KD (max. 8 here) for the control information. The remainder of the header field has 44 bits and may be used for other purposes. A block of eight control data packets KD, each with six bytes, follows the header field.

The variant presented previously for transferring a request for a container for user data packets for filling with control data packets is not used to permit unscheduled transmission of control information to terminal T, because the normal resource request is used here. This resource request functions by having the terminal calculate the demand for the following MAC transmission frame, and then send an information element to master station ZE with this request. This request can be made for any virtual connection, for any service class or for all of them together. This variant is normally appropriate only when the required signaling overhead is reduced by using a container for user data packets for filling with control information. Depending on the type of signaling of resource assignments by the master station, this is possible if signaling is necessary for each individual container.

The alternative presented last for the agreement for filling a container for user data packets with control data packets can be implemented according to the alternative with transfer of a request signal, with the difference that an automated method is used here, where terminal T continues to request control data packets KD, but they are allocated by master station ZE on exceeding a certain number of requested control data packets as one or more long PDUs within a container for user data packets.

For the first two variants, a concrete embodiment is given, it

being assumed that terminal T should be given the opportunity to transmit extensive urgent control information. This may occur in particular in the case of a handover, because large quantities of control information, e.g., connection parameters, must be transmitted here very rapidly under some circumstances - e.g., in the event of rapidly deteriorating channel properties. If the required capacities had to be requested first, it could happen that the connection would be interrupted before that. Another application case is a transiently bad channel. In this case, packets received with errors would have to be requested again from the master station (automatic repeat request). Since the number of new requests may be enormously high, in this case the occurrence of control information is increased and thus the demand for control data packets KD is increased.

If transmission of a large amount of control information is urgently needed, terminal T converts a container for user data packets LD, which was originally provided for transmission of user data, into a container for control data packets KD.

As an example of the announcement of a converted container for user data packets LD within a preceding control data packet KD, it is assumed here that four control data packets KD and three user data packets LD are available for terminal T in question. In addition, a handover is assumed, necessitating in this phase the transmission of six control data packets KD. Furthermore, it is assumed that each container for user data packets LD is accompanied by a respective control data packet KD in that the information elements are associated with statements, e.g., regarding the respective virtual connection.

Terminal T then seeks out the virtual connection having the least urgent data and uses the container for user data packets LD provided for it for transmission of the necessary information elements having handover information in six control data packets KD, as illustrated in Figure 6. Preceding

control data packet KD contains an information element having an identifier (IE type) which indicates that this is information for converting a container for user data packets LD. The second field (length) contains the number of occupied control data packets KD within user data packet container LD. The container is then filled with required control data packets KD. The remainder either remains free or is filled with other control information.

The second variant - announcement of the mode in header field KF of a user data packet - which can be used under the conditions described here, may be used if the condition that a respective control data packet KD is available to each container for user data packets LD does not hold. Then, a maximum of eight control data packets KD are packed into one container for user data LD. The remaining six bytes are used to perform the required announcement. In addition, a distinguishing feature between a container in which user data packets LD are stored and a container in which a block of control data packets KD is stored is necessary. This is accomplished by a field in the header field of all containers having a length of 64 bytes, differentiating between user data, e.g., flag = 0, and control data, e.g., flag = 1 (see Figure 5).

Figure 7 shows a schematic diagram of the design of a master station ZE for a communications system according to the present invention, i.e., with a frame-oriented transmission of data packets of differing capacity between master station ZE and a plurality of subscribers T, with master station ZE allocating communications resources in the form of data packets for subscribers T and subscribers T requesting communications resources from master station ZE. A frame generator RZG is used to generate a transmission frame which has been preselected for the transmission. Control data packets KD and user data packets LD are inserted via a multiplexer MZX into the transmission frame generated by frame

generator RZG and are relayed to a transmission device, i.e., to a transmitter TZX in the case of a wireless network. On the basis of the agreement between master station ZE and subscribers T, selection unit AZS determines whether containers for user data packets LD are filled with a plurality of control data packets KD within the transmission frame or whether normal user data packets LD are being transmitted. Data packets transmitted by subscribers T are received by a receiving device RZX and broken down into control data packets KD and user data packets LD by demultiplexer DZX. Control data packets KD and user data packets LD are compiled anew by analyzer unit AZE for a subsequent transmission frame or for relaying to the network (output AZU). Analyzer unit AZE also controls selection unit AZS, depending on whether a subscriber T has an increased demand for control data packets (in handover) and whether containers for user data packets LD must be replaced by control data packets KD.

Figure 8 shows the design of a subscriber device of a subscriber T having modules corresponding to master station ZE: multiplexer MTX, demultiplexer DTX, analyzer unit ATE, selection unit ATS, send and receive device RTX, TTX and frame generator RTG, although it is controlled here on the basis of the frame clock pulse which is predetermined by master station ZE (connection of analyzer unit ATE to frame generator RTG). In contrast with master station ZE, the subscriber device according to Figure 8 does not have any direct network access.

ABSTRACT OF THE DISCLOSURE

For effective utilization of data packets of differing capacity transmitted in a communications network, an agreement is made between a master station and subscribers to fill containers for user data packets with a plurality of control data packets in the transmission frame. Urgent control information, e.g., in a handover in a wireless transmission system can thus be transmitted efficiently.

[10191/1963]

METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM

[Background Information

]FIELD OF THE INVENTION

The present invention [is based on]relates to a method of effective utilization of data packets of differing capacity transmitted between a master station and a plurality of subscribers in a communications system. In addition, the present invention relates to a master station for a communications system having frame-oriented transmission of data packets of differing capacity between the master station and a plurality of subscribers, as well as relating to a corresponding subscriber device.

BACKGROUND INFORMATION

In centrally controlled communications networks, e.g., in the centrally controlled wireless cellular network according to the HIPERLAN type 2 ETSI project, there is a master station ZE to which multiple subscribers or their terminals can be connected (see Figure 1). This wireless network operates on a connection-oriented basis, i.e., at least one connection must be established before data can be exchanged with other subscribers or their terminals connected to the network or to master station ZE. On the basis of subscriber requests, the master station assigns to the terminals the data rate they need on the medium they share. It is possible for a subscriber terminal to have more than one active virtual connection at the same time, as is the case with ATM. In one implementation of this network, both the resource requests by the terminals and the resource assignments by master station ZE are carried out per connection, i.e., the terminal transmits the quantity of data packets that must be transmitted for each of its

connections. Supplying data rates during which data can be transmitted on the medium is considered a resource here. Accordingly, master station ZE sends a resource assignment for each connection of the terminal. In other implementations of this network, however, there is the possibility of performing the resource assignment and resource request per terminal, i.e., the terminal itself can decide which data packets it will send. In the case of the resource assignment per connection, the fact that a data packet transmitted belongs to a connection is given implicitly by the assignment of master station ZE, so this information is already present in master station ZE and [therefore]does not need [not]to be[transmitted] additionally transmitted by the terminal.

In the case of the resource assignment per terminal, master station ZE does not have any advance information regarding to which connection of the terminal a received data packet belongs. In this variant, the terminal must therefore transmit this information additionally. The same thing is true of a resource request or assignment per traffic class, as [described]discussed in detail in [[1] and in the essential points in [2] ([1]:]D. Petras, "Entwicklung und Leistungsbewertung einer ATM-Funkschnittstelle" [Development and performance evaluation of an ATM wireless interface], Dissertation at RWTH Aachen, Aachen, chapter 8.2, DynPara-PDU; and in D. Petras, [[2]:]U. Vornefeld, "Joint performance of DSA++MAC protocol for wireless ATM under realistic traffic and channel models" wmATM '98, Hangzhou, China 1998, chapter 4[])].

In the above-mentioned wireless network, two different data packet sizes are provided for the data to be transmitted. Short packets (approx. 6 bytes; short data container: KD) are used for transmission of control information, i.e., information that is not user data but instead is used to control and manage the network, [i]e.[e]g., to establish connections, to associate terminals, to perform handovers or

to request retransmission of incorrectly received data packets. Long data containers LD have a length of approx. 54 bytes and are normally used to transmit user data. In addition to the user data per se, some other information which is very closely related to the user data is also included, e.g., the sequence number or a checksum for error detection.

A transmission in a downlink direction (master station to subscriber) as well as in an uplink direction (terminal to master station) includes a number of control data packets KD at the beginning and a subsequent number of user data packets LD according to Figure 2. The exact number of control data packets KD and user data packets LD is specified by master station ZE in the resource assignment.

[Advantages of the Invention

The measures according to Claims 1 or 12 and 13 give] SUMMARY OF THE INVENTION

In accordance with the present invention, subscribers or their terminals are given an opportunity to use a container for user data packets for transmission of control information. This opportunity is advantageous in particular when long control information must be transmitted, as is the case in handover or terminal association (logging a terminal onto the master station before establishing data communication). In addition, due to the use of a container for user data packets for multiple short control data packets, the terminal is given an opportunity to send urgent control information even without a prior request.

Due to the simple possibility of sending control information in data containers actually intended for user data, the terminal has an opportunity to respond much more flexibly, rapidly and efficiently to a changed situation. This is very beneficial, in particular in wireless transmission with its

rapidly changing wireless channel properties. In addition, [due to] in accordance with the [method proposed here] example embodiment of the present invention, a terminal has an opportunity to transmit a large amount of control information more efficiently.

[The subordinate claims describe advantageous embodiments of the method, the] BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a master station [and the subscriber devices.

Drawings

Embodiments of the present invention are explained in greater detail on the basis of additional drawings, which show:

Figure 3:] connected to a network and wirelessly connected to terminals.

Figure 2 shows an exemplary embodiment of a set of control packets and user data packets.

Figure 3 shows filling a container for user data packets with control data packets[;].

Figure 4[:] a transmission burst of a subscriber terminal in an uplink[;].

Figure 5[:] the accommodation of a header field in addition to control data packets in a container for user data packets[;].

Figure 6[:] the announcement of a block of control data packets in a container for user data packets[;].

Figure 7[:] the design of the master station for a communications system according to the present invention[, and].

Figure 8[:] the design of a subscriber device for a communications system according to the present invention.

[Description of Embodiments
]DETAILED DESCRIPTION

There are two different types of data containers of differing capacities in the above-mentioned HIPERLAN type 2 communications network. Data packets having a length of approx. 6 bytes usually contain control information. They are referred to below as control data packets KD. Data packets having a length of approx. 54 bytes, i.e., having a data capacity amounting to a multiple of that of the above-mentioned data packets, contain, in addition to user data NF, only a short header field KF containing data (e.g., sequence number and error correction bits) belonging directly to the container contents. These data packets are referred to below as user data packets LD (Figure 3). User data packets LD and control data packets KD are exchanged between a master station ZE and subscriber terminals T using a frame-oriented transmission (Figure 1).

In particular in the case when a subscriber or its terminal T would like to transmit urgent control information, according to the present invention, terminal T is given an opportunity to fill a container for user data packets LD with a plurality of control data packets KD.

This is illustrated in Figure 3. In the transmission frame, a container for user data packets LD is filled with nine control data packets KD. To do so, however, master station ZE must know that it is not a normal container having user data. To this end, an agreement between master station ZE and a subscriber T according to the present invention is reached so that containers for user data packets LD are filled with control data packets KD which are transmitted together, and it specifies which containers for user data packets in the

transmission frame are filled with control data packets KD in each case. There are different methods of reaching this agreement:

1. by having one terminal announce it in a preceding control data packet KD; this procedure presupposes an analysis of control data packets KD prior to analysis of user data packets;
2. by announcing the mode in header field KF of a user data packet LD;
3. by transmitting a request through a terminal T to master station ZE to be able to fill a container for user data packets with control data packets;
4. by establishing a fixed agreement that after a certain number of requests of control data packets KD by a terminal T, instead a container for user data packets LD is assigned by master station ZE for filling with control data packets KD.

Control data packets KD stored in containers for user data packets LD [are preferably]may be combined in a subframe whose external format is adapted to the format of a user data packet LD, even if the number of control data packets KD to be transmitted at the moment is not sufficient to fill the container completely.

The four possibilities shown here for an agreement to fill containers for user data packets LD with control data packets KD are described below in detail.

In the first [possibility]exemplary embodiment, data transmission of a terminal (transmission burst) involves an uplink by transferring a block of control data packets KD followed by a block of user data packets LD according to Figure 4. One of these control data packets KD or a portion thereof is used to transfer information about the content of a

subsequent container for user data packets which is filled with a block of control data packets KD (LD control according to Figure 4). To do so, a new information element IE is defined which determines the number of occupied fields for control data packets KD within a certain container for user data packets LD. In addition, information must be included which determines which of the subsequent containers is intended for user data packets LD (shown as an arrow in Figure 4). This may be a pointer - for example, the information that the n-th container for user data packets contains x control data packets KD. A determination can also be implemented that all containers for user data packets LD that are filled with a sequence of control data packets KD must be sent at a certain position within a block of user data packets, e.g., at the beginning (not shown in Figure 4). In this case, it is sufficient to merely state the number of control LD. This information element is sent by the terminal in one of control data packets KD that is present anyway. Another possibility is that there is an information element IE in a previous control data packet KD for each user data packet LD, so that the assignment is made simply by the sequence.

It [is]<u>may be</u> possible, as explained[briefly] above, to insert a field into the container for user data packets LD, in particular into the header field, containing the information about which type of information it contains. This is labeled as a flag field in Figure 5. One bit, for example, is sufficient for this. This is followed then by another field (number of KD) which contains the number of the following control data packets KD (max. 8 here) for the control information. The remainder of the header field has 44 bits and may be used for other purposes. A block of eight control data packets KD, each with six bytes, follows the header field.

The variant presented previously for transferring a request for a container for user data packets for filling with control

data packets is not used to permit unscheduled transmission of control information to terminal T, because the normal resource request is used here. This resource request functions by having the terminal calculate the demand for the following MAC transmission frame, and then send an information element to master station ZE with this request. This request can be made for any virtual connection, for any service class or for all of them together. This variant is normally appropriate only when the required signaling overhead is reduced by using a container for user data packets for filling with control information. Depending on the type of signaling of resource assignments by the master station, this is possible if signaling is necessary for each individual container.

The alternative presented last for the agreement for filling a container for user data packets with control data packets can be implemented according to the alternative with transfer of a request signal, with the difference that an automated method is used here, where terminal T continues to request control data packets KD, but they are allocated by master station ZE on exceeding a certain number of requested control data packets as one or more long PDUs within a container for user data packets.

For the first two variants, a concrete embodiment is given, it being assumed that terminal T should be given the opportunity to transmit extensive urgent control information. This may occur in particular in the case of a handover, because large quantities of control information, e.g., connection parameters, must be transmitted here very rapidly under some circumstances - e.g., in the event of rapidly deteriorating channel properties. If the required capacities had to be requested first, it could happen that the connection would be interrupted before that. Another application case is a transiently bad channel. In this case, packets received with errors would have to be requested again from the master

station (automatic repeat request). Since the number of new requests may be enormously high, in this case the occurrence of control information is increased and thus the demand for control data packets KD is increased.

If transmission of a large amount of control information is urgently needed, terminal T converts a container for user data packets LD, which was originally provided for transmission of user data, into a container for control data packets KD.

As an example of the announcement of a converted container for user data packets LD within a preceding control data packet KD, it is assumed here that four control data packets KD and three user data packets LD are available for terminal T in question. In addition, a handover is assumed, necessitating in this phase the transmission of six control data packets KD. Furthermore, it is assumed that each container for user data packets LD is accompanied by a respective control data packet KD in that the information elements are associated with statements, e.g., regarding the respective virtual connection.

Terminal T then seeks out the virtual connection having the least urgent data and uses the container for user data packets LD provided for it for transmission of the necessary information elements having handover information in six control data packets KD, as illustrated in Figure 6. Preceding control data packet KD contains an information element having an identifier (IE type) which indicates that this is information for converting a container for user data packets LD. The second field (length) contains the number of occupied control data packets KD within user data packet container LD. The container is then filled with required control data packets KD. The remainder either remains free or is filled with other control information.

The second variant - announcement of the mode in header field

KF of a user data packet - which can be used under the conditions described here, [should preferably]may be used if the condition that a respective control data packet KD is available to each container for user data packets LD does not hold. Then, a maximum of eight control data packets KD are packed into one container for user data LD. The remaining six bytes are used to perform the required announcement. In addition, a distinguishing feature between a container in which user data packets LD are stored and a container in which a block of control data packets KD is stored is necessary. This is accomplished by a field in the header field of all containers having a length of 64 bytes, differentiating between user data, e.g., flag = 0, and control data, e.g., flag = 1 (see Figure 5).

Figure 7 shows a schematic diagram of the design of a master station ZE for a communications system according to the present invention, i.e., with a frame-oriented transmission of data packets of differing capacity between master station ZE and a plurality of subscribers T, with master station ZE allocating communications resources in the form of data packets for subscribers T and subscribers T requesting communications resources from master station ZE. A frame generator RZG is used to generate a transmission frame which has been preselected for the transmission. Control data packets KD and user data packets LD are inserted via a multiplexer MZX into the transmission frame generated by frame generator RZG and are relayed to a transmission device, i.e., to a transmitter TZX in the case of a wireless network. On the basis of the agreement between master station ZE and subscribers T, selection unit AZS determines whether containers for user data packets LD are filled with a plurality of control data packets KD within the transmission frame or whether normal user data packets LD are being transmitted. Data packets transmitted by subscribers T are received by a receiving device RZX and broken down into

control data packets KD and user data packets LD by demultiplexer DZX. Control data packets KD and user data packets LD are compiled anew by analyzer unit AZE for a subsequent transmission frame or for relaying to the network (output AZU). Analyzer unit AZE also controls selection unit AZS, depending on whether a subscriber T has an increased demand for control data packets (in handover) and whether containers for user data packets LD must be replaced by control data packets KD.

Figure 8 shows the design of a subscriber device of a subscriber T having modules corresponding to master station ZE: multiplexer MTX, demultiplexer DTX, analyzer unit ATE, selection unit ATS, send and receive device RTX, TTX and frame generator RTG, although it is controlled here on the basis of the frame clock pulse which is predetermined by master station ZE (connection of analyzer unit ATE to frame generator RTG). In contrast with master station ZE, the subscriber device according to Figure 8 does not have any direct network access.

[Literature:

1. D. Petras, "Entwicklung und Leistungsbewertung einer ATM-Funkschnittstelle" [Development and performance evaluation of an ATM wireless interface], Dissertation at RWTH Aachen, Aachen 1998

2. D. Petras, U. Vornefeld, "Joint performance of DSA++MAC protocol for wireless ATM under realistic traffic and channel models" wmATM '98, Hangzhou, China 1998

[10191/1963]

METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM

Background Information

The present invention is based on a method of effective utilization of data packets of differing capacity transmitted between a master station and a plurality of subscribers in a communications system. In addition, the present invention relates to a master station for a communications system having frame-oriented transmission of data packets of differing capacity between the master station and a plurality of subscribers, as well as relating to a corresponding subscriber device.

In centrally controlled communications networks, e.g., in the centrally controlled wireless cellular network according to the HIPERLAN type 2 ETSI project, there is a master station ZE to which multiple subscribers or their terminals can be connected (see Figure 1). This wireless network operates on a connection-oriented basis, i.e., at least one connection must be established before data can be exchanged with other subscribers or their terminals connected to the network or to master station ZE. On the basis of subscriber requests, the master station assigns to the terminals the data rate they need on the medium they share. It is possible for a subscriber terminal to have more than one active virtual connection at the same time, as is the case with ATM. In one implementation of this network, both the resource requests by the terminals and the resource assignments by master station ZE are carried out per connection, i.e., the terminal transmits the quantity of data packets that must be transmitted for each of its connections. Supplying data rates during which data can be transmitted on the medium is considered a resource here.

Accordingly, master station ZE sends a resource assignment for each connection of the terminal. In other implementations of this network, however, there is the possibility of performing the resource assignment and resource request per terminal, i.e., the terminal itself can decide which data packets it will send. In the case of the resource assignment per connection, the fact that a data packet transmitted belongs to a connection is given implicitly by the assignment of master station ZE, so this information is already present in master station ZE and therefore need not be transmitted additionally by the terminal.

In the case of the resource assignment per terminal, master station ZE does not have any advance information regarding to which connection of the terminal a received data packet belongs. In this variant, the terminal must therefore transmit this information additionally. The same thing is true of a resource request or assignment per traffic class, as described in detail in [1] and in the essential points in [2] ([1]: chapter 8.2, DynPara-PDU, [2]: chapter 4).

In the above-mentioned wireless network, two different data packet sizes are provided for the data to be transmitted. Short packets (approx. 6 bytes; short data container: KD) are used for transmission of control information, i.e., information that is not user data but instead is used to control and manage the network, i.e., to establish connections, to associate terminals, to perform handovers or to request retransmission of incorrectly received data packets. Long data containers LD have a length of approx. 54 bytes and are normally used to transmit user data. In addition to the user data per se, some other information which is very closely related to the user data is also included, e.g., the sequence number or a checksum for error detection.

A transmission in a downlink direction (master station to subscriber) as well as in an uplink direction (terminal to

master station) includes a number of control data packets KD at the beginning and a subsequent number of user data packets LD according to Figure 2. The exact number of control data packets KD and user data packets LD is specified by master station ZE in the resource assignment.

Advantages of the Invention

The measures according to Claims 1 or 12 and 13 give subscribers or their terminals an opportunity to use a container for user data packets for transmission of control information. This opportunity is advantageous in particular when long control information must be transmitted, as is the case in handover or terminal association (logging a terminal onto the master station before establishing data communication). In addition, due to the use of a container for user data packets for multiple short control data packets, the terminal is given an opportunity to send urgent control information even without a prior request.

Due to the simple possibility of sending control information in data containers actually intended for user data, the terminal has an opportunity to respond much more flexibly, rapidly and efficiently to a changed situation. This is very beneficial, in particular in wireless transmission with its rapidly changing wireless channel properties. In addition, due to the method proposed here, a terminal has an opportunity to transmit a large amount of control information more efficiently.

The subordinate claims describe advantageous embodiments of the method, the master station and the subscriber devices.

Drawings

Embodiments of the present invention are explained in greater detail on the basis of additional drawings, which show:

Figure 3: filling a container for user data packets with control data packets;

Figure 4: a transmission burst of a subscriber terminal in an uplink;

Figure 5: the accommodation of a header field in addition to control data packets in a container for user data packets;

Figure 6: the announcement of a block of control data packets in a container for user data packets;

Figure 7: the design of the master station for a communications system according to the present invention, and

Figure 8: the design of a subscriber device for a communications system according to the present invention.

Description of Embodiments

There are two different types of data containers of differing capacities in the above-mentioned HIPERLAN type 2 communications network. Data packets having a length of approx. 6 bytes usually contain control information. They are referred to below as control data packets KD. Data packets having a length of approx. 54 bytes, i.e., having a data capacity amounting to a multiple of that of the above-mentioned data packets, contain, in addition to user data NF, only a short header field KF containing data (e.g., sequence number and error correction bits) belonging directly to the container contents. These data packets are referred to below as user data packets LD (Figure 3). User data packets LD and control data packets KD are exchanged between a master station ZE and subscriber terminals T using a frame-oriented transmission (Figure 1).

In particular in the case when a subscriber or its terminal T

would like to transmit urgent control information, according to the present invention terminal T is given an opportunity to fill a container for user data packets LD with a plurality of control data packets KD.

This is illustrated in Figure 3. In the transmission frame, a container for user data LD is filled with nine control data packets KD. To do so, however, master station ZE must know that it is not a normal container having user data. To this end, an agreement between master station ZE and a subscriber T according to the present invention is reached so that containers for user data packets LD are filled with control data packets KD which are transmitted together, and it specifies which containers for user data packets in the transmission frame are filled with control data packets KD in each case. There are different methods of reaching this agreement:

1. by having one terminal announce it in a preceding control data packet KD; this procedure presupposes an analysis of control data packets KD prior to analysis of user data packets;
2. by announcing the mode in header field KF of a user data packet LD;
3. by transmitting a request through a terminal T to master station ZE to be able to fill a container for user data packets with control data packets;
4. by establishing a fixed agreement that after a certain number of requests of control data packets KD by a terminal T, instead a container for user data packets LD is assigned by master station ZE for filling with control data packets KD.

Control data packets KD stored in containers for user data packets LD are preferably combined in a subframe whose external format is adapted to the format of a user data packet LD, even if the number of control data packets KD to be

transmitted at the moment is not sufficient to fill the container completely.

The four possibilities shown here for an agreement to fill containers for user data packets LD with control data packets KD are described below in detail.

In the first possibility, data transmission of a terminal (transmission burst) involves an uplink by transferring a block of control data packets KD followed by a block of user data packets LD according to Figure 4. One of these control data packets KD or a portion thereof is used to transfer information about the content of a subsequent container for user data packets which is filled with a block of control data packets KD (LD control according to Figure 4). To do so, a new information element IE is defined which determines the number of occupied fields for control data packets KD within a certain container for user data packets LD. In addition, information must be included which determines which of the subsequent containers is intended for user data packets LD (shown as an arrow in Figure 4). This may be a pointer - for example, the information that the n-th container for user data packets contains x control data packets KD. A determination can also be implemented that all containers for user data packets LD that are filled with a sequence of control data packets KD must be sent at a certain position within a block of user data packets, e.g., at the beginning (not shown in Figure 4). In this case, it is sufficient to merely state the number of control LD. This information element is sent by the terminal in one of control data packets KD that is present anyway. Another possibility is that there is an information element IE in a previous control data packet KD for each user data packet LD, so that the assignment is made simply by the sequence.

It is possible, as explained briefly above, to insert a field into the container for user data packets LD, in particular

into the header field, containing the information about which type of information it contains. This is labeled as a flag field in Figure 5. One bit, for example, is sufficient for this. This is followed then by another field (Anz. [number of] KD) which contains the number of the following control data packets KD (max. 8 here) for the control information. The remainder of the header field has 44 bits and may be used for other purposes. A block of eight control data packets KD, each with six bytes, follows the header field.

The variant presented previously for transferring a request for a container for user data packets for filling with control data packets is not used to permit unscheduled transmission of control information to terminal T, because the normal resource request is used here. This resource request functions by having the terminal calculate the demand for the following MAC transmission frame, and then send an information element to master station ZE with this request. This request can be made for any virtual connection, for any service class or for all of them together. This variant is normally appropriate only when the required signaling overhead is reduced by using a container for user data packets for filling with control information. Depending on the type of signaling of resource assignments by the master station, this is possible if signaling is necessary for each individual container.

The alternative presented last for the agreement for filling a container for user data packets with control data packets can be implemented according to the alternative with transfer of a request signal, with the difference that an automated method is used here, where terminal T continues to request control data packets KD, but they are allocated by master station ZE on exceeding a certain number of requested control data packets as one or more long PDUs within a container for user data packets.

For the first two variants, a concrete embodiment is given, it

being assumed that terminal T should be given the opportunity to transmit extensive urgent control information. This may occur in particular in the case of a handover, because large quantities of control information, e.g., connection parameters, must be transmitted here very rapidly under some circumstances - e.g., in the event of rapidly deteriorating channel properties. If the required capacities had to be requested first, it could happen that the connection would be interrupted before that. Another application case is a transiently bad channel. In this case, packets received with errors would have to be requested again from the master station (automatic repeat request). Since the number of new requests may be enormously high, in this case the occurrence of control information is increased and thus the demand for control data packets KD is increased.

If transmission of a large amount of control information is urgently needed, terminal T converts a container for user data packets LD, which was originally provided for transmission of user data, into a container for control data packets KD.

As an example of the announcement of a converted container for user data packets LD within a preceding control data packet KD, it is assumed here that four control data packets KD and three user data packets LD are available for terminal T in question. In addition, a handover is assumed, necessitating in this phase the transmission of six control data packets KD. Furthermore, it is assumed that each container for user data packets LD is accompanied by a respective control data packet KD in that the information elements are associated with statements, e.g., regarding the respective virtual connection.

Terminal T then seeks out the virtual connection having the least urgent data and uses the container for user data packets LD provided for it for transmission of the necessary information elements having handover information in six control data packets KD, as illustrated in Figure 6. Preceding

control data packet KD contains an information element having an identifier (IE type) which indicates that this is information for converting a container for user data packets LD. The second field (length) contains the number of occupied control data packets KD within user data packet container LD. The container is then filled with required control data packets KD. The remainder either remains free or is filled with other control information.

The second variant - announcement of the mode in header field KF of a user data packet - which can be used under the conditions described here, should preferably be used if the condition that a respective control data packet KD is available to each container for user data packets LD does not hold. Then a maximum of eight control data packets KD are packed into one container for user data LD. The remaining six bytes are used to perform the required announcement. In addition, a distinguishing feature between a container in which user data packets LD are stored and a container in which a block of control data packets KD is stored is necessary. This is accomplished by a field in the header field of all containers having a length of 64 bytes, differentiating between user data, e.g., flag = 0, and control data, e.g., flag = 1 (see Figure 5).

Figure 7 shows a schematic diagram of the design of a master station ZE for a communications system according to the present invention, i.e., with a frame-oriented transmission of data packets of differing capacity between master station ZE and a plurality of subscribers T, with master station ZE allocating communications resources in the form of data packets for subscribers T and subscribers T requesting communications resources from master station ZE. A frame generator RZG is used to generate a transmission frame which has been preselected for the transmission. Control data packets KD and user data packets LD are inserted via a multiplexer MZX into the transmission frame generated by frame

generator RZG and are relayed to a transmission device, i.e., to a transmitter TZX in the case of a wireless network. On the basis of the agreement between master station ZE and subscribers T, selection unit AZS determines whether containers for user data packets LD are filled with a plurality of control data packets KD within the transmission frame or whether normal user data packets LD are being transmitted. Data packets transmitted by subscribers T are received by a receiving device RZX and broken down into control data packets KD and user data packets LD by demultiplexer DZX. Control data packets KD and user data packets LD are compiled anew by analyzer unit AZE for a subsequent transmission frame or for relaying to the network (output AZU). Analyzer unit AZE also controls selection unit AZS, depending on whether a subscriber T has an increased demand for control data packets (in handover) and whether containers for user data packets LD must be replaced by control data packets KD.

Figure 8 shows the design of a subscriber device of a subscriber T having modules corresponding to master station ZE: multiplexer MTX, demultiplexer DTX, analyzer unit ATE, selection unit ATS, send and receive device RTX, TTX and frame generator RTG, although it is controlled here on the basis of the frame clock pulse which is predetermined by master station ZE (connection of analyzer unit ATE to frame generator RTG). In contrast with master station ZE, the subscriber device according to Figure 8 does not have any direct network access.

Literature:

1. D. Petras, "Entwicklung und Leistungsbewertung einer ATM-Funkschnittstelle" [Development and performance evaluation of an ATM wireless interface], Dissertation at RWTH Aachen, Aachen 1998

2. D. Petras, U. Vornefeld, "Joint performance of DSA++MAC

protocol for wireless ATM under realistic traffic and channel models" wmATM '98, Hangzhou, China 1998

What is claimed is:

1. A method of effective utilization of data packets of differing capacity, which are transferred in a communications system having frame-oriented transmission between a master station (ZE) and a plurality of subscribers (T), user data packets (LD) and control data packets (KD) being exchanged between the master station (ZE) and the subscribers (T), and the user data packets (LD) each having a multiple of the data capacity of the control data packets (KD), comprising the following steps:

- by agreement between the master station (ZE) and subscribers (T) containers for user data packets (LD) are each filled with a plurality of control data packets (KD) in the transmission frame,
- the agreement stipulates which containers for user data packets (LD) are filled with control data packets (KD).

2. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by an announcement in a control data packet (KD) transmitted in advance.

3. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by an announcement in a header field (KF) of a block of control data packets (KD) transmitted cohesively at the time.

4. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by transmitting a request signal from a subscriber (T) to the master station (ZE).

New Claims

What is claimed is:

1. A method of effective utilization of data packets of differing capacity, which are transmitted in a communications system having frame-oriented transmission, between a master station (ZE) and a plurality of subscribers (T), with user data packets (LD) and control data packets (KD) being exchanged between the master station (ZE) and the subscribers (T), and the user data packets (LD) having a multiple of the data capacity of the control data packets (KD), having the following steps:

- by agreement between the master station (ZE) and subscribers (T), containers for user data packets (LD) are each filled with a plurality of control data packets (KD) in the transmission frame,
- the agreement stipulates which containers for user data packets (LD) are filled with control data packets (KD),
- the control data packets (KD) which are stored in containers for user data packets (LD) are combined in a subframe which is adapted in its external format to the format of a user data packet (LD).

2. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by an announcement in a control data packet (KD) transmitted in advance.

3. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by an announcement in a header field (KF) of a block of control data packets (KD) transmitted cohesively at the time.

4. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by transmitting a request signal from a subscriber (T) to the master station (ZE).

5. The method according to Claim 1,
wherein the agreement for filling the containers for user data packets (LD) with control data packets (KD) is made by the fact that, after a certain number of requests for control data packets (KD) by a subscriber (T), a container for user data packets (LD) is instead assigned by the master station (ZE) for transmission of control data packets (KD).

6. The method according to one of Claims 1 through 5,
wherein a control data packet (KD) or a part thereof is used to transmit information regarding the type and/or content of subsequent containers for user data packets (LD) which are filled with control data packets (KD).

7. The method according to Claim 6,
wherein an information element (IE) is stored in a control data packet (KD) which contains information about the number of occupied fields for the control data packets (KD) within a certain subsequent container for user data packets (LD).

8. The method according to one of Claims 1 through 7,
wherein a control data packet (KD) or a part thereof is used to indicate information regarding the position of the container for user data packets (LD) which is filled with control data packets (KD) within a block of user data packets (LD).

9. The method according to one of Claims 1 through 7,
wherein all the containers for user data packets (LD) that are filled with control data packets (KD) are arranged in a predetermined position within a block of user data packets

(LD) or at the beginning of a cohesive block of user data packets (LD).

10. The method according to one of Claims 1 through 8, wherein an information element (ID) is stored in a preceding control data packet (KD) for each container for user data packets which is filled with control data packets.

11. A master station (ZE) for a communications system having frame-oriented transmission of data packets of differing capacity between the master station (ZE) and a plurality of subscribers (T), the master station (ZE) allocating communications resources in the form of data packets for the subscribers (T), and the subscribers (T) requesting communications resources from the master station (ZE), the master station (ZE) including the following modules:
- a frame generator (RZG) for predefining a transmission frame
- a multiplexer (MZX) which is suitable for inserting control data packets (KD) and user data packets (LD), whose data capacity amounts to a multiple of the data capacity of the control data packets (KD), into the predefined transmission frame, the control data packets (KD) which are stored in containers for user data packets (LD) being combined in a subframe whose external format is adapted to the format of a user data packet (LD),
- a selection unit (AZS) which determines, on the basis of an agreement between the master station (ZE) and subscriber (T), whether containers for user data packets (LD) within the transmission frame are filled with a plurality of control data packets (KD),
- a demultiplexer (DZX) which is suitable for separating user data packets (LD) and control data packets (KD) transmitted in a transmission frame and sending them to the selection unit (AZS).

12. A subscriber device for a communications system having frame-oriented transmission of data packets of differing

capacity between a master station (ZE) and a plurality of subscribers (T), the master station (ZE) allocating communications resources in the form of data packets for the subscribers (T), and the subscribers (T) requesting communications resources (ZE), the subscriber device including the following modules:

- a demultiplexer (DZX) which is suitable for separating user data packets (LD) and control data packets (KD) from a transmission frame transmitted by the master station (ZE) and sending them to an analyzer unit (ATE),
- a multiplexer (MTX) which is suitable for inserting subscriber-side control data packets (KD) and user data packets (LD), whose data capacity amounts to a multiple of the data capacity of the control data packets (KD), into a transmission frame predefined by the master station (ZE), the control data packets (KD) which are stored in containers for user data packets (LD) being combined in a subframe which is adapted in its external format to the format of a user data packet (LD),
- a selection unit (ATS) which determines, on the basis of an agreement between the master station (ZE) and subscriber (T), whether containers for user data packets (LD) are filled with a plurality of control data packets (KD) within the transmission frame.

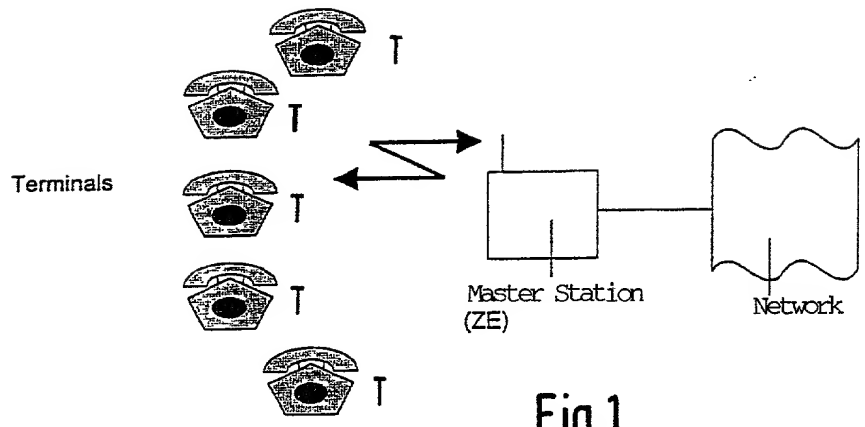


Fig.1

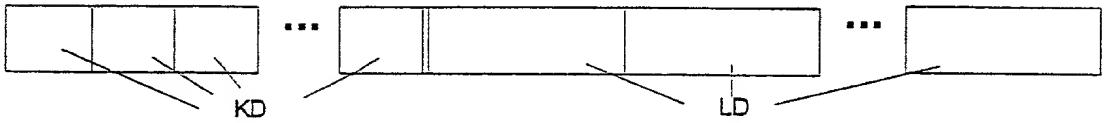


Fig.2

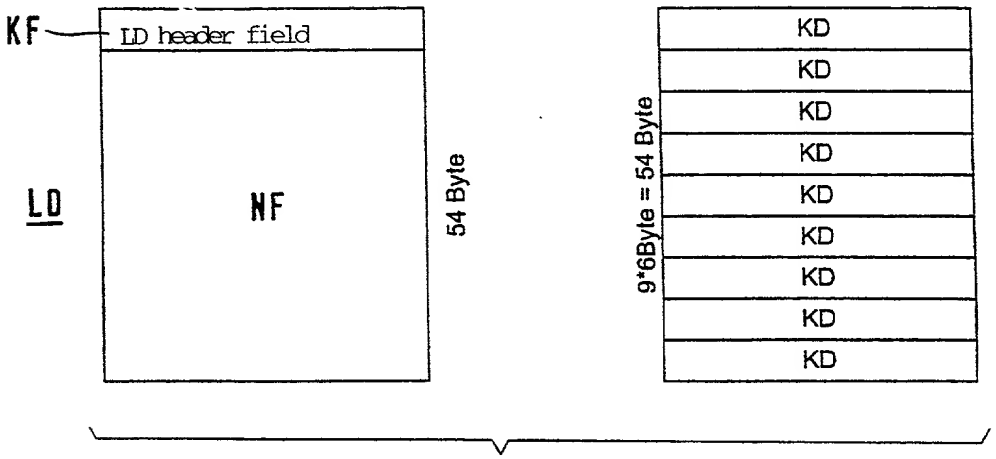


Fig.3

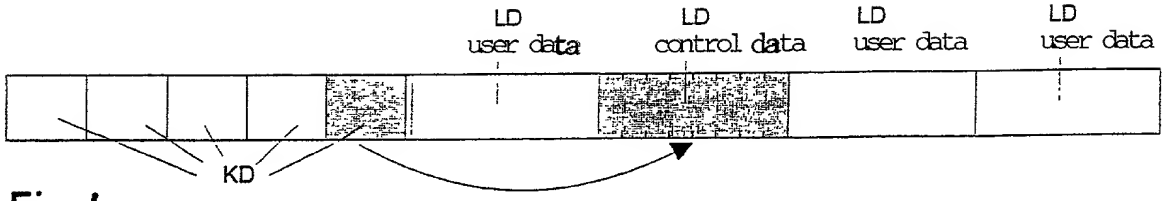


Fig.4

Flag	no. of KD	Remainder	KD	KD	KD	KD	KD	KD	KD	KD
1 Bit	3 Bit	44 Bit	6 Byte	6 Byte	6 Byte	6 Byte	6 Byte	6 Byte	6 Byte	6 Byte

Fig.5

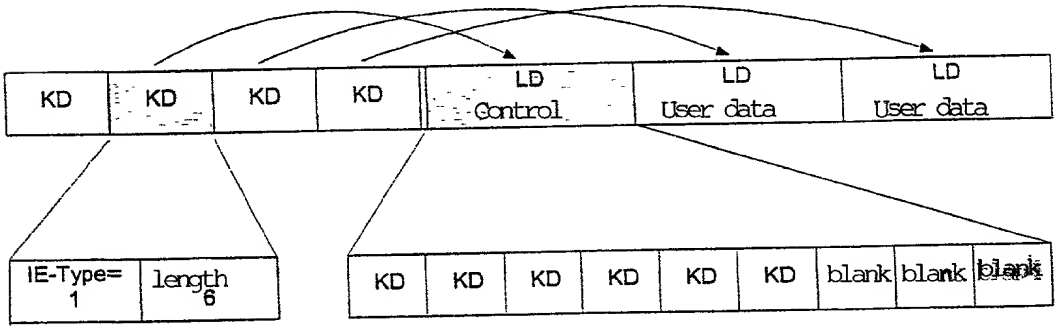


Fig.6

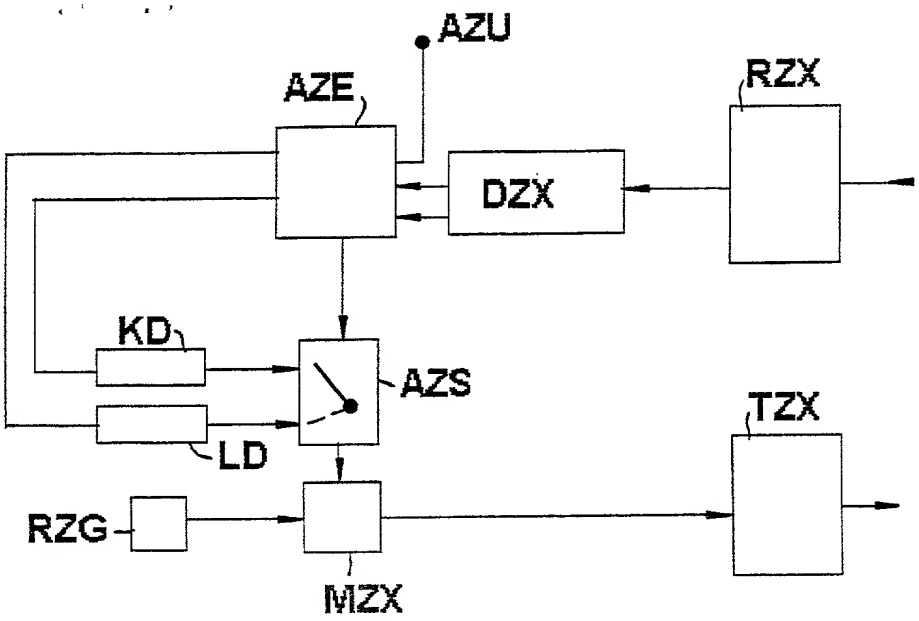
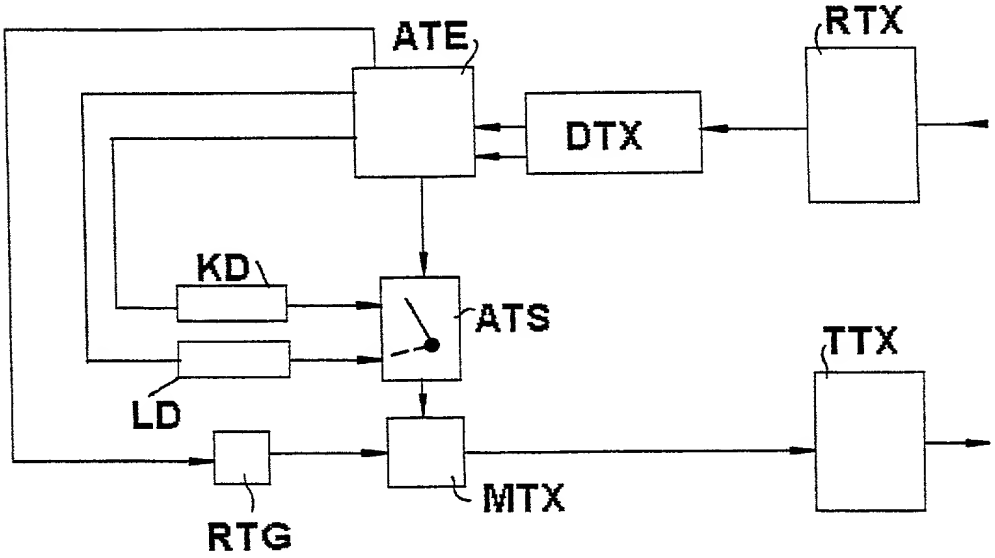

AZU
AZE
RZX
DZX
KD
AZS
TZX
LD
RZG
MZX

Fig.7

Fig.8


ATE
RTX
DTX
KD
ATS
TTX
LD
MTX
RTG

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD OF EFFECTIVE UTILIZATION OF DATA PACKETS OF DIFFERING CAPACITY AND A MASTER STATION AND SUBSCRIBER DEVICE FOR A COMMUNICATIONS SYSTEM**, and the specification of which:

[ ] is attached hereto;

[ ] was filed as United States Application Serial No. _____ on _____, 19__ and was amended by the Preliminary Amendment filed on _____, 19__.

[x] was filed as PCT International Application Number PCT/DE00/00380, on the 8th day of February, 2000

[x] an English translation of which is filed herewith.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international

application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S)
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119

Country : Federal Republic of Germany

Application No. : 199 07 020.2

Date of Filing: 19 February 1999

Priority Claimed
Under 35 U.S.C. § 119 : [x] Yes [ ] No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR
PCT INTERNATIONAL APPLICATIONS
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120

U.S. APPLICATIONS

Number :

Filing Date :

PCT APPLICATIONS
DESIGNATING THE U.S.

PCT Number :

PCT Filing Date :

I hereby appoint the following attorney(s) and/or agents to prosecute the above-identified application and transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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